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COMMODITY PRICE VOLATILITY AND OUTPUT GROWTH; A COMPARATIVE ANALYSIS OF NIGERIA AND GHANA.

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ABSTRACT

This study examines the relationship between commodity price volatility and Output Growth in Nigeria and Ghana between 1990 to 2014.The Data for the study was sourced from Central Bank of Nigeria and Ghana Statistical Bulletins, World Bank Online Data Base and International Monetary Fund Online Data Base. The study employs E (GARCH) and Structural Vector Autoregressive Model as estimation techniques. Findings from the study show that unstable commodity price has negative impact on the growth of both Nigerian and Ghanaian economies during the study periods. However, the magnitude of commodity price impact on Output Growth is higher in Nigeria than Ghana. Based on these findings, it is recommended that economic diversification and physical policy (Export promotion through import substitute) are required in both Nigeria and Ghana to achieve sustainable economic growth.

Key words: Commodity price, Volatility, Output Growth, Nigeria and Ghana.

INTRODUCTION

Majority of commodity markets are inherently volatile, and volatility itself is highly prone to fluctuation over time. The commodity price volatility which has always been a prerequisite to inflationary pressures has much negative impacts on the economies of every nation developed and developing. However, the magnitude varies. The impact is more pronounced in developing economies than developed ones.

Commodity price volatility affects prices, production and inventories in two principal ways. First, it directly affects the marginal value of storage, when prices, production, and demand are more volatile, there is a higher demand for inventories which are required to increase the effectiveness of production and deliveries, and this reduces market costs. Thus, an increase in volatility can lead to inventory build-ups and increase in commodities prices in the short – run. Secondly, for a deflectable resource like a oil, volatility affects the total marginal cost of production option premium. (Joseph, Omojolaibi and Festus, 2013)

Inflationary pressure that has been militating against growth of many economies globally can not only be attributed to oil price fluctuation but also to commodity prices fluctuations especially food prices. The global increase in the food prices of 80's, especially wheat, soya beans and corn, was as a result of increased in oil price at world oil market. The implication of this is that, there is a link among commodity price, global oil price and output growth (Alexander, et al, 2008)

There are many factors responsible for global fluctuations in food prices. Some of these factors are; the gap between supply and demand, the growing presence of financial investors and speculators in commodity markets in case of financialization of commodities, the unpredictable weather which influenced the planting seasons and population momentum (Browne & Cronin, 2010).

Moreover, in Nigeria, increase in oil price at world oil market especially in 80s, 90s, and to some extent early 2000s led to excessive foreign exchange earnings, which resulted into the neglect of other valuable sectors (Agriculture, manufacturing, services etc.). This, to some extent, brought instability in commodity prices across the country. Also in Ghana, the appreciable prices of cocoa and gold at global market between the 1970's and 1980's caused shift of attention from other commodities to these two commodities (Gold and cocoa) This to some extent led to commodity prices fluctuations and instability in Ghana.

Furthermore, concerns over commodity price and inflation are required not just because they raise costs of production of goods by the producers but also because there is evidence to support that they have been entangled with increasing overall consumer prices, (Dehn, 2000). Studying the nature of the general price level and its effect on growth in an economy might not be exhaustive except a special attention is paid to commodity prices fluctuations.

The nature of commodity prices volatility has been characterized either by symmetric or asymmetric effect. In the literature, many of the studies had only considered asymmetric effect. (Samson, 2004); (Latintie, 1999); (Solomon, 2006) and (Angus, 1999). However, in critical viewing of the relationship, both symmetric and asymmetric effects should be considered. Also, majority of the studies on the relationship have been either on country specific or on regional basis. Therefore, this study seeks to consider the relationship between these two important macroeconomic variables (commodity price and output growth) in the two largest economies in West Africa Sub-region, that is Ghana and Nigeria.

The latter part of the paper is structured as follows. The introductory section is followed by section two that presents theoretical issues and empirical literature. The third section consists of theoretical framework, Methods, Materials and Estimation Techniques. Section four deals with the presentation of results and its analysis. Section five concludes the paper.

LITERATURE REVIEW

In this section, some relevant concepts are clarified and recent empirical literatures are discussed.

Conceptual Issues

Output growth: This refers to an increase in productive capacity of a nation over a period of time that leads to increase in per capital income or Gross National Product. However, the importance of this process lies in the fact that it increases the productive capacity of a nation which permits a further use of its resources thereby reducing its dependence on other nations.

Asymmetric and Symmetric Relationship.

Asymmetric economic theory occurs when economy behaves in a radical departure from the inherent fluctuations in economic activity. This idea of asymmetry came up in 1920s during the great world depression. During these periods, economic analysists had a notion that policy makers should be able to control the level that could increase or decrease the economic activities. Therefore, to solve these multidimensional problems of great economic depression of 1920s, the traditional Keynesian Asymmetry was adopted, which emphasized that positive monetary policy shocks have smaller real effects than negative monetary policy shocks (Ball and Gregory, 1994).

Symmetric Economic Theory

This occurs when economic disturbance affects all parts of a unit simultaneously, for instance, all nations of a monetary union, all regions of a country or all sectors within a union or country (Haderson, 2006).

Commodity price dynamics

This concept discusses fluctuation in the commodity prices which could be symmetric or asymmetric in nature. Therefore, commodity prices are being extracted from fundamental sources behind the price dynamics and that commodity price co-movements are mostly from the sparse cluster factors that represent correlations of distinct group of commodities.

Commodity price volatility

These are pricing signals that are created as a result of changing in supply and demand levels in the market. It is a price signals from the continual changes in both supply and demand for products. This is also the standard deviation in a given period.

Relationship among commodity price dynamics, volatility and output growth The revenue from commodity exports provides a potential source of investment funds which is the major determinant of output growth. Even, temporary price booms provide windfalls if wisely invested, can also enhance future growth and development. It has been argued that countries rich in resources are not blessed but cursed. This is because they grow more slowly than resource poor economies (Gelb, 1988) and (Auty, 1993) cited in (Angus, 1999). This is because of dutch deuses. That is, shifting from one sector to another sector.

Empirical Literature

Several empirical studies have been conducted on the relationship between commodity prices volatility and macroeconomic performance, especially in developed economies. Some of these studies are hereby presented. (Joels & Mignon 2011) for instance, examined the long-run relationship between energy forward prices and their distinct maturities in some selected African countries. The study employed a non-linear panel co-integration as estimation techniques. Findings from the study revealed that the relationship between oil prices, gas and coal was proportional.

In a related study, (Nazlioglu, 2012), studied the relationship between oil prices and agricultural commodity price dynamics in some selected European nations. Panel Co-integration and Granger Causality Test were used as estimation techniques. The empirical results showed that an increase in oil prices simultaneously brings about increase in agricultural commodity prices. (Azzoni *et al*, 2006), examined the impact of dynamics international prices of agricultural products on income distribution and poverty in Brazil. The study made used of descriptive statistics as estimation technique. Findings from the study showed that a general price increase in agricultural products resulted in a high level of poverty and income inequality during the study periods.

In an elaborate study of (Delong & Summers 2012), in which some selected countries in African were considered, the relationship between commodity price dynamics and tax revenues was considered. Panel Co-integration and Error Correlation were used as estimation techniques. The empirical results showed that an increase in commodity prices reduced the government tax revenue during the study periods. (Cashin, 2002), examines the impact of commodity price dynamics on economic growth of some selected nations in Africa. A Panel Co-integration and error correction was used as estimation technique. The results reveal that an increase in commodity prices brought about an increase in net national saving in selected nations during the study periods.

In a similar study, (Noemic, 2011), examine the causes of price dynamics in world coffee and cocoa commodity markets in some selected Latin America nations. The study uses panel Vector Autoregressive Distributive Model as estimation technique. Findings show that coffee price dynamics has uneven or differing reactions depending on the nature of the market interactions. As regards cocoa, there was a recorded long run equilibrium relationship with oil. (Oyejide 2010), examines the impact of commodity price dynamics on resources in Nigeria. The study employs Co-integration and Error Correction as Estimation Technique. Findings show that commodity price dynamics significantly reduces resource firm equity prices and their demand for reproduced and natural capital during the study periods.

(Paul, 2008), examines the relationship among commodity prices, growth, and the Natural Resource Curse in sub-Saharan Africa. The vector Autoregressive Distributive Model was employed as estimation technique. Findings showed that there was a strong evidence of resource curse. Also, from the findings, commodity booms have positive short-term effects on output, but adverse long-term effects. (Angus, 1999), studies the relationship between commodity price dynamic and macroeconomic performance in Africa. This study employs a descriptive statistics. That Natural resources are as abundant in Africa as human capital is scarce, and Africa is likely to have a comparative advantage in exports of primary commodities for many years to come. Conclusively, from the review of empirical literature above, it is obvious that majority of the studies on the relationship between commodity prices dynamics volatility and output growth were carried out in advanced economies, devoid of country specific or comparative analysis. Even those few studies on Africa were on regional

basis. We are not unaware of the problem with panel or pooled studies. That may not be able to show the individual characteristics of selected countries.

To solve these identified gaps, this study considers the relationship between commodity prices volatility and output growth in the two largest economies in West African sub-region.

METHODS

This section presents theoretical underpinning, methods, material and sources of data.

The Theoretical Underpinning

The model for this paper takes it foundation from Sticky and Flexible Price Model which was introduced and integrated by (Fedderkke, 2003). The theory emphasizes that money was brought into the growth model through savings. Growth theory shows that for an economy to be in equilibrium then s = sy = 1= $\frac{dy}{dx}$. According to this model, there are only two non-storable goods in the economy whose volume are somehow unstable but all add up to make the total economy output Y. The general price level P, is a combination of both Sticky Price goods P^s and flexible Price Goods P^f. their weight are given by their respective share of trade. Because of space constraint, we may not be able to show the mathematical illustrations of this model. However, the summary has been presented.

The model and data sources

From empirical literature, it is obvious that previous research works applied ordinary least square, Co-integration, and Error Correction and Causality test to estimate their models. However, several of these studies were country specific. This study however, intends to fill this identified gap by taking a radical departure from these previous studies by focusing on bi-country analysis. To get a clear understanding of the transmission mechanism of commodity price volatility to output growth, a panel vector autoregressive model is constructed.

Panel VAR Model

(PVAR) method has become an effective tool of analysis both in theoretical and applied economics to interpret business cycle fluctuations and to decompose the dynamic effect of fluctuations on economic policies. That the PVAR approach imposes restrictions on the reduced forms makes it appealing and appropriate for this study. The paper intends to examine the relationship between commodity price volatility and output growth in Nigeria and Ghana. Therefore, the variables are;

GDP_{gr} = Output Growth Rate, OCP = Oil Commodity Price Volatility, NOCP =, Non-Oil Commodity Price Volatility, IMPV = Import Commodity Price Volatility, EXCPV = Export Commodity Price Volatility, EXR = Exchange Rate and INF = Inflation Rate.

$$GDP_{gr} = Y_{10} + y_{11}ocp_{t-1} + y_{12}nocp_{t-1} + y_{13}impv_{t-1} + Y_{14}excpv_{t-1} + y_{15}exr_{t-1} + y_{17}INF_{t-1} + \sum GDP_{gr}$$

$$ocp = Y_{20} + y_{21}GDP_{gr+} + y_{23}nocp_{t-1} + y_{24}impv_{t-1} + y_{25}excpv_{t-1} + y_{26}exr_{t-1} + y_{27}inf_{t-1} + \sum ocp$$

$$nocp = Y_{30} + y_{31}ocp = + y_{21}GDP_{t-1+}y_{31}impv_{t-1} + y_{32}excpv + y_{33}exr_{t-1} + y_{34}inf_{t-1} + \sum nocp$$

$$impv = Y_{41} + y_{42}nocp + y_{43}ocp\ Y_{t-1} + y_{44}GDP_{t-1+}y_{45}excpv_{t-1} + \gamma_{46}exr_{t-1} + \gamma_{47}inf_{t-1} + \sum impv$$

$$inf = y_{50} + y_{51}\, impv = + y_{52}\, nocp + \ y_{53} ocp\ Y_{t-1} + \ y_{54}\, GDP_{t-1} + y_{55} excpv_{t-1} + \ \gamma_{56} exr_{t-1} \sum inf$$

$$exr = y_{60} + y_{61}\, impv = + y_{62}\, nocp + \ y_{63} ocp\ Y_{t-1} + \ y_{64}\, GDP_{t-1} + y_{65} excpv_{t-1} + \ \gamma_{66} exr_{t-1} \sum exr$$

$$excpv = y_{70} + y_{71}\, impv + \ y_{72}\, nocp + \ y_{73} ocp\ Y_{t-1} + \ y_{74}\, GDP_{t-1} + y_{75} excpv_{t-1} + \ \gamma_{76} exr_{t-1} \sum excpv\} \ldots\ldots\ldots 3.1$$

The model (3.1) is called structural panel VAR since it is assumed to be derived from some underlying economic theory. The exogenous error terms are independent and are interpreted as structural innovations. By re-arranging the equation (1), putting all the endogenous variables to left and differentiating between the lagged variables. The interactions of the variables in the two countries, the following matrix equation is obtained.

$$A2_{ce} = X_i + \ \beta 2_{ce-1} CX_t + E_{ct} \ldots\ldots\ldots\ldots 3.2$$

$$A = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 \\ -x2 & 0 & 1 & 0 & 1 \\ -\beta & 1 & 0 & 0 & 0 \\ -\lambda & 0 & 0 & 1 & 0 \\ -\mu & 1 & 0 & 0 & 1 \end{pmatrix}$$

$$B = \begin{pmatrix} X_1 & 0 & 0 & 0 & 0 \\ 0 & \lambda_1 & 0 & 0 & 0 \\ 0 & 0 & \beta & 0 & 0 \\ 0 & 0 & 0 & Y_1 & 0 \\ 0 & 0 & 0 & 0 & \mu \end{pmatrix} \quad C = \begin{pmatrix} 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Where 2ct is the vector of endogenous seven variable vector of commodity price volatility and growth in Ghana and Nigeria. A, is taken to be the matrix of lagged interactions C is the matrix of external time interaction Xc is the vector of constants for each countries Xt is the vector of exogenous variables from the rest of the world at time t and $\sum_{ct}$ is the vector of structural disturbance which are normally distributed with zero, constant variance and serially uncorrelated while X, λ, β, Y, and μ are the structural parameters.

Identification of growth rate of Gross Domestic Product is obtained by a methodology known as the Recursive Method. This approach takes that the Growth Rate of Gross Domestic Product does not response contemporaneously to shocks to other variables in the system. Therefore, a reduced model with variables such as growth rate of Gross Domestic Product, OCP = Oil Commodity Price Volatility, NOCP =, Non-Oil Commodity Price Volatility, IMPV = Import Commodity Price Volatility, EXCPV = Export Commodity Price Volatility, EXR = Exchange Rate, INF = Inflation Rate are model in equation 3.3.

However, the vector of the variable is given thus.

$$GDPgr = f(\ ocp, nocp, imcpv, excpv, exr, ifr)$$

The VAR model reads thus

$$Y_t = A_1 + B_1 X_t + \sum_{j=1}^{P} CjY_{t-j} + \sum_{j=1}^{pi} DjX_{t-j} + U_{1t}$$

$$X_t = A_2 + B_2 Y_t + \sum_{j=1}^{P} EjY_{t-j} + \sum_{j=1}^{pi} FjX_{t-j} + U_{2t} \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

Source of Data

The Data for this study are mainly quarterly data that are obtained from National Bureau of Statistics, Central Bank of Nigeria, Ghana Statistical Bulletin, World Bank Online Data Base and International Monetary Fund Online Data Base.

Estimation of commodity price volatility

The commodity prices are inherently volatile and volatility itself varies over time. However, in measuring volatility, generally GARCH model and its families are always use.

Formally, the GARCH model can be written as follows

$$Y(t) = x(t) + e(t)$$

$$e(t) = e(t)_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

$$Z(t) = \alpha o + P\sum_{t=1} x\, 1_{t-1} + q\sum_{t=1} x2_{t-1} \ldots . \quad 3.5$$

Where the conditional information set at time t – 1 is denoted by $\mathfrak{y}_L - 1$. The variance of the ARCH process exists when $\sum x < 1$ and is given by (y (t) = α 0/(1 - ∑x1). Change in log of either oil price/non-oil price x(t) is a jxk vector of lagged endogenous variables incorporated in the information set P is a KxJ vector of unknown parameters. Equation 3.5 is the variance equation, which contains three components is constant, last period volatility (the ARCH term) and last period variance. (the GARCH term). The autoregressive root which governs the persistence of volatility shocks is the sum of α and β if the sum or α and β is very close to unity then the shocks dies out rather slowly. Therefore, the existence of volatility is based on the above volatility modeling process.

Estimating Techniques

To estimate the volatility, exponential GARCH model is to be employed and to estimate the relationship between commodity price volatility and output growth, Structural VAR model is to be used.

RESULTS

This section deals with results presentation and it analysis.

From the result in table 4.1 in the appendix, all the variables of interest are integrated of the same order.1(1) Since the condition for E GARCH (1) has been met, then we can now proceed to estimate the various Commodity Prices separately.

Volatility consistency and Asymmetry for Nigeria

To investigate the commodity price volatility, a full and sub-periods are employed. Since this is done; it is possible to observe Consistency and Asymmetry in these periods differently.

From the results in table 4.2 in the appendix, the estimated parameters have intriquiring implications. The conditional shock parameters show a statistically significant and negative for both periods (full period and sub- period). From this result, we can conclude that the variance in the commodity prices is unstable and volatile. This require much time for

the shocks to die out. Also, we can conclude that the commodity prices volatility in Nigeria during the study periods is persistent in both full periods and sup-periods.. As regards the asymmetric response parameters Y, this is statistically significant and negative for both full periods and sub – periods. The implication of this is that there is an evidence of asymmetric Commodity Prices Volatility in Nigeria during study periods.

This result however has some implications on the microeconomic performance in Nigeria. It makes financial and economic planning cumbersome. This may be responsible for why several strategies and development policies embark upon by governments which are projected on commodity prices (including oil price and non-oil export) revenue had always failed.

Structural Vector Autoregressive Distributive Model Estimates for Nigeria.

The five different information criteria that are required in the bi-variate Vector Autoregressive model are presented in table 4.3 In the appendix. It should be noted that all the lag lengths determined by these criteria met the required stability conditions in the vector autoregressive distributive model. To consider Schwarz information criteria and parameter parsimony, the optimum lag length for the VAR model is assumed to be l.

Portmanteau Test for autocorrelation and Breuch – Godfrey. Lag range multiplier (Lm) tests that use multivariate Box – pierce/Ljung – Box Q – statistics for VAR (1) model residuals found no autocorrelation up to 10 quarterly lags.

The impact of commodity price volatility on the growth of Nigerian Economy

Based on the results on the table 4.3 in the appendix, the null hypothesis of no heteroscadasticity in residuals is taken or accepted. However, the estimation of Structural Vector Autoregressive model is interpreted below.

$$O(1) = \begin{pmatrix} 0.0346 & 0 \\ -0.0265 & 0.0342 \end{pmatrix}$$

From the above matrix, the response of output growth to commodity price volatility is given to be – 0.0265 point. Taking the absolute value, dt is significant.

$$\theta(1) = \sum x\text{-}0 \quad \theta 22 \quad = -0.265$$
$$(-5.1231)$$
$$(0.000)$$

Also from the above results, statistics (-5.1231) is high but with low P – value. The implication of this is that, unstable commodity prices have negative impact on the output growth in Nigeria during the study periods.

In the table 4.4 in the appendix, the result of Variance Decomposition was presented. Note that to arrive at various figures above, structural factorization was conducted. From the above results, conditional volatility shocks accounts for 40.3% of the variation in the Output Growth forecast error of these variations only 62.56% is explained by the shocks. This means that 40.3% of the variation in the Output Growth in Nigeria during the study periods is responsible for by Commodity Price Volatility. Also, the remaining 62.7% is caused by variation in Output itself.

Results from table 4.6 in the appendix show Augmented Dickey fuller unit root test for Ghana. From the result, all the variables of interest are integrated of the same order. That is, integrated of order (1). The implication of this is that, the condition for E (GARCH) has

been satisfied. Therefore, we can now proceed to estimate the Commodity Prices volatility, Consistency and Asymmetry.

As it was presented in table 4.2 for Nigeria, the study period are divided into two (full period and sub-period). The parameters of the conditional shock are statistically insignificant and positive for full Period and negative for sup-period.

The implication of this is that the commodity price has a mean reverting process and this process means reverts slowly in the Full-Periods. Therefore, in the Sub-Period, the variance in the commodity price is stable but not very volatile. Expectedly and in most occasions reverts quickly to its original position. However, in the full periods, it was Volatile, Persistent and Asymmetric. This means that it require much time for shocks to die out. Also, in the full period, volatility and shocks in commodity price is not as a result of new volatility and shocks from the previous periods. This is as a result of speculation around prices by markets agent as a result of future speculations.

Impact of Commodity Prices Volatility on the Growth of Ghananian Economy

Inference from result on table 4.7 in the appendix, the null hypothesis of no heteroscadasticity in residual is accepted. Therefore, the estimation of structural vector autoregressive model is interpreted in the below matrix.

$$0(1) = \begin{pmatrix} 0.0243 & 0 \\ 0.0112 & 0.0241 \end{pmatrix}$$

From the above matrix, the response of output growth to commodity price volatility is given to be – 0.0112 point.

$$0\frac{1}{2}(1) = \sum_{x=0}^{x} \theta_{21}{}^{(3)} = -\underset{\substack{[-6.1411] \\ [0.0000]}}{0.0164}.$$

From the above table, t–statistic (-2.324) is low also with low P – value. The implication of this is that, commodity prices fluctuation has negative impact on the output growth in Ghana during the study periods. However, the magnitude is not as high as that of the impact on Output Growth in Nigeria.

In the table 4.8 in the appendix, result of variance Decomposition was presented. However, structural factorization was carried out to arrive at various figures. From the above table, the conditions volatility shocks accounts for 50.5% of the variation in the output forecast error. Out of these variations 49.4% is explained by the shocks. The implication of this is that 50.5% of variation in output growth in Ghana is responsible for by variation in commodity price volatility. 49.4% of this is explained by shocks emanating from Growth rate of output itself.

Comparative Analysis of Commodity Prices Volatility Growth Between Nigeria And Ghana

In both countries (Nigeria and Ghana) all the variables of interest are stationary at the first difference. This is indication of the fact that they are all integrated of the same order. Integrated of order (1). The volatility test through E (GARCH) show different results. The impact is more pronounced in Nigeria than Ghana. The negative impact is higher in Nigeria than in Ghana. The reason for this might be because of the fact that Nigeria is a full mono-

economy, that is entirely depends on crude oil price at world oil market. Incidentally, crude oil prices are highly volatile and unpredictable in the world oil market.

CONCLUSION

This paper examines the impact of commodity prices volatility on Output Growth in Nigeria and Ghana between 1990 and 2014.

The commodity price, investigated in this study show that commodity price volatility has the greatest influence on the economies of both countries examined. However, it has much negative impact on the output growth in Nigeria than Ghana. It can equally be concluded that the transmission mechanism through which commodity price volatility affects Nigerian and Ghanaian economies is exchange rate. Based on these findings, it is recommended that Nigerian and Ghanian economies need to be diversified and that the level of exports should be enhanced. This is to be achieved through physical policy. (Import substitution through export promotion).

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APPENDIX

Table 4.1 Nigeria Augmented Dickey fuller Test unit Root Test

Variable	P Statistics	Order or integration
GDPgr	-8.934567	1(1)
OCP	-12.45621	1(1)
NOCP	-11.52345	1(1)
IMPCPV	-11.23465	1(1)
EXCPV	-10.27345	1(1)
EXR	-7.664561	1(1)
IFR	-9.234562	1(1)

Table 4.2 Conditional variance Estimates

Sample Period	Mean equation	Condition variance
1990Q1–2014Q4b	ARMA(.25)	EGMRCH (1,1)
1990Q-2001Q4	ARMA(4,4)	EGARCH(1,1)
2004Q1–2011Q4	ARMA(2,4)	EGARCH(1,1)

Notes * ** and *** denote statistical significance at 1%, 5% and 10% levels respectively t – statistics are provided in parentheses. Error distribution is Guassian.

	α_1	β_1	Y_1
-8.3341	-0.6344***	-0.69245	-0.56241*
(-10.3221	(-8.4213)	(-4.6725)	(-3.2261)
-4.1304*	-1.5431**	0.5431*	-21346*
(-4.0312	(3.5662)	(2.7245)	(-2.6245)
-2.6212	1.6602	0.4261	-0.3627
(-22.6223)	(-20.6243)	(1.03E08)	(-2.4624)

Table 4.3 VAR lag order selection criteria.

Lags	LR	FPE	AIC	SCE	HQ
0	11.23	1.16e-06	-7.68	-7.33	-8.21
1	10.92	6.66e-07	-8.23	-7.46	-7.20
2	28.21	7.63e-71	-7.31	-8.21	-7.18
3	0.62	3.11e-07	-7.41	-8.23	-7.15
4	0.72	8.13e-07	-7.88	-7.03	-8.22
5	0.61	9.21e-07	-8.2	-8.26	-8.03
6	11.22	3.16e-06	-8.3	-7.32	-8.21
7	1.36	2.15e-96	-7.67	-8.14	-8.11

8	5.61	2.21e-06	-8.22	-7.03	-7.64

Table 4.4: variance decomposition of growth rate of gross domestic product.

Period	**Standard error**	**Shock**	**Shock output**
1	0.03462	40.30231	62.56211
2	0.033461	40.64241	62.82345
3	0.033441	40.53311	62.56221
4	0.034562	40.63231	62.564567
5	0.033132	40.52221	62.56332
6	0.032112	40.46221	62.56344
7	0.031321	40.34562	62.564562
8	0.033122	40.45521	62.564563
9	0.033111	40.62233	62.566211
10	0.032213	40.56211	62.56422

Note: That structural factorization was performed

Table 4.6 Ghana Augmented Dickey fuller unit

Root Test.

Variable	p-statistics	Order of integration
GDPgr	-5.4142	1(1)
OCP	-8.8265	1(1)
NOCP	-4.7622	1(1)
IMPCPV	-6.3441	1(1)
EXCPV	-5.3121	1(1)
EXR	-4.8221	1(1)
IFR	-6.3311	1(1)

Table 4.7 **GARCH RESULT FOR GHANA**

The regression shows the nature of the volatility of variance of commodity prices volatility.

Ghana E (GARCH) results

1990Q1–2014Q4b ARMA(.25) EGARCH (1,1)

1990Q-2001Q4 ARMA(4,4) EGARCH(1,1)

2004Q1–2011Q4 ARMA(2,4) EGARCH(1,1)

Q	Q_1	β_1	Y_1
– 7.3421	-0.5234	-0.7241	-0.5241
(-4.1403)	(-7.2342)	(-4.5231)	(-2.3456)
-4.2342	-1.4321	0.4321	-2.423
(-4.0234)	(3.4231)	(2.6234)	(-3.4562)
-3.6412	1.5503	0.3241	-0.4323
(-21.2456)	(-23.7421)	(1.3107)	(-3.4234)

Table 4.8: VAR Lag order selection criteria.

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Lags	LR	FPE	AIC	SCI	HQ
0	9.11	2.11e-04	-6.45	-6.45	-9.45
1	8.24	8.23e-06	-6.34	-6.11	-8.22
2	3.15	4.23e-07	-8.45	-6.23	-9.45
3	2.62	6.45e-08	-8.22	-6.45	-9.11
4	0.62	5.62e-0.5	-8.45	-7.11	-9.04
5	0.45	4.11e-05	-7.62	-7.12	-7.06
6	3.46	2.14e-06	-6.45	-7.15	-8.42
7	5.33	3.16e-07	-6.11	-8.11	-7.45
8	0.45	6.18e-07	-8.24	-9.21	-6.45

Structural factorization was performed

Table 4.7: Variance Decomposition of real growth of Gross Domestic Product.

Period	Standard error	Shock	Shock output
1	0.02456	50.2345	49.88452
2	0.04567	50.4234	49.621123
3	0.044221	30.45622	49.61124
4	0.052611	50.60234	49.49123
5	0.02245	50.46478	49.39622
6	0.045622	50.7244	49.324562
7	0.045621	50.8122	49.24562
8	0.034231	50.2344	49.78456
9	0.024112	50.6221	49.38234
10	0.034211	50.2341	49.76256

Note: Structural factorization was performed.